Valuation of derivative assets, FMSN25/MASTM24

Course programme HT-18

Home page
The course homepage is [http://www.maths.lth.se/matstat/kurser/fmsn25masm24/](http://www.maths.lth.se/matstat/kurser/fmsn25masm24/)

Course expedition
Department Course secretary Maria Lövgren in room 225 A+B in Math-building, southern part.
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Course responsible
Magnus Wiktorsson, room MH 130, phone: 046-222 86 25, e-mail: magnusw@maths.lth.se

Computer exercise assistants
Philip Kennerberg
Carl Åkerlindh

Lectures and Exercises

**Lecturer:**
LP1(First half of semester): Magnus Wiktorsson

**Teaching assistant:**
LP1: Philip Kennerberg, Carl Åkerlindh

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<td>8–10</td>
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Home assignment
The home assignment is handed out in reading reading week 4. It should be handed in on October 12 at 17 at the latest. It is then corrected. The errors should be corrected and the home assignment should be handed in again for correction.

Computer exercises
The course has two compulsory computer exercises lasting 2 and 4 hours respectively. The computer exercises are in rooms E:Neptunus and E:Pluto.

**Comp Exer 1** (Reading week 2: Tue September 11, at 13-15, 2h.) The computer exercise deals with valuation of options in discrete time using Binomial trees. You will price both European and American type options. You will moreover study the convergence rate for Binomial trees.

**Comp Exer 2** (Reading week 6: Tue October 9 at 13-17 4h.) Valuation of derivatives can be done through Monte Carlo simulations. This is the main theme in Computer Exercise 2. You will moreover apply various techniques to improve the simulations.

**Note** that there is an extra lecture about om simulation related to the computer exercise rw 5.
Literature

- T. Björk (2009) *Arbitrage Theory in Continuous Time*. 3rd. ed. Oxford University Press. (2nd ed. of Björk from 2004 will also work. It is available as e-book for students with stil identities:
  \[ \text{http://www.oxfordscholarship.com.ludwig.lub.lu.se/osopubliccontent/economicsfinance/9780199271269/toc.html} \]
  See \[ \text{http://www.maths.lth.se/matstat/kurser/fmsn25masm24/ht17/chtrans.html} \] for translation between the chapter numbers in 3rd and 2nd ed of Björk)


The compendium *Derivative Pricing* contains material for some lectures, exercises and answers to the exercises. It is sold at KF-sigma.

Handed out papers  All papers handed out on the lectures will be downloadable from the course home-page.

Examination

The exam is in the form of one home assignment and a written exam. To pass the course you need

- Correctly completed the home assignment.
- Participated on both the compulsory computer exercises.
- Obtained a passing grade on the written exam. A passing grade is 3, 4 for 5 LTH students and G or VG for faculty of science students. Allowed aid: pocket calculator, pencil and eraser.

Exam

Ordinary exam: Saturday **October 27, 2018** at 8–13 in VIC:1D.
First Re-exam: Wednesday **January 9, 2019** at 8–13 MA:8A.
Second Re-exam: Friday **August 28, 2019** at 14–19 MA:9C.

Course content under first half of semester

The chapters are either in T. Björk's bok (B) or S. Åberg (former Rasmus) compendium (Å) and Solved problems handout (P). L is for lectures, E is for teacher assisted exercises. An asterisk (*) after an exercise means that it should be done if you have time. The numbers after Week “1(36)” means reading week and calendar week respectively.

Week 1(36)

L1: Introduction, definition of different contracts, the economic model and concepts, discrete time models especially the Binomial model in one and multiple periods [Å 1-1.2, A 2, B 2].
E1: Å 2.(6–8), B 2.(1–3) *Typo in B 2.1b II(1;X) = X should be II(1;X) ≠ X*, Å 3.(1).
L2: Last part of discrete time models [B.2, B.3, Å.3]. Probability theory. [Å 13 (see also B appendix B)]
E2: Å 3.(2–3) Å 13 (1,5,8,9), P1.5.1.

Week 2(37)

L3: The Wiener Process [Å 4.1], The Ito-Integral and Ito's formula.[B 4. (1–5), Å 5.(1–2].
E3: Å 4.(2,3+6,9), B 4.(1 (a-d)), Å 4.(10-12).
L4: Filtering, Martingales [Å 4.2, B 4.4]. More Ito's formula and stochastic calculus [Å 5. (3,4), B 4. (5–8)].
E4: Å 4.(14,16,17), Å 5.(2,3(a),4,6,7),B 4.(7*), P1.1.2.
Week 3(38)

L5: SDE:s Geometric Brownian motion, The Ornstein-Uhlenbeck process. The Feynman-Kac’s formula. [B 5., Å 5.(3,5)]
E5: Å 5.(9,10,11), P(1.1.1), B 4.(2,4,8), B 5.(5–9).
L6: Portfolio dynamics, Arbitrage-pricing (Classic) [B 6. och B 7.(1–4)].
E6: B 5.(10-12), B 7.(1, 2, 4–7), P (1.3.1).

Week 4(39)

Home assignment is handed out.
L7: B&S-formula [B 7.5]. Completeness [B 8.(1–3)]
and hedging in the B&S model[B 8.(1–3),Å 8].
E7: B 8.3, B 9.(2–4, 8–10), P(1.4.1).
L8: Complete, incomplete markets and the modern Arbitrage-pricing [Å 10. B 10.7, 15.]
E8: Å 6.4, Å 10.(2–4,6–8), P(1.5.2).

Week 5(40)

L9: Change of Numerairs and its applications. [Å 10.3, B 26.1-5].
E9: Å 10. (9,10,12,13,15), P(1.6.1),(1.7.1).
L10: Extra lecture, Tue at 13-15 in MH:309A Beyond the Black-Scholes model. [(Å.7)].
L11: Simulation (a lecture related to computer exercise 2). [Å 11].

Week 6(41)

Home assignments should be handed in before the end of the week (Fri at. 17)
Computer exercise 2. (Tue) Simulation (9/10 at 13–17).
L12: Introduction to Interest rate theory; Basic products and their arbitrage relations [ B 22., Å 1.4–1.5.3].
E10: B 22.(2, 3, 5, 7), Å 1.(3,6,9), P(1.6.2, 1.8.1).
L13: Market models (LIBOR market models) [B 27].
E11: B23.(1-4).

Week 7(42)

L14: Short rate models [B.23–24].
E12:B 24.(1 (abc), 5, 6) B 25.(1, 2, 5) , P 1.8.1.
L15: Martingale models for the short rate and HJM models [B.24–25].
E13: P 1.9.1,1.9.2 Recapitulation and questions.

Week 8(43)


Exam

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